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## Full Coverage for Hypertension Drugs in Rural Communities in China

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### Abstract

**Background**—The control rate for hypertension is unacceptably low worldwide, and poor adherence to medication is a primary reason.

**Objectives**—To evaluate the impact of full coverage for hypertension drugs on adherence to medication, medical costs, and hypertension control in Shandong Province, China.

**Methods**—In November 2009, we interviewed 110 hypertensive patients who had been participating in a free medication program since May 2008 and 241 hypertensive patients who were not participating. We used a 1:1 propensity-score matching technique to obtain matched samples of 102 program participants (intervention) and 102 nonparticipants (control). We used univariate analysis to compare patient drug-taking behaviors, medical costs, and hypertension control between the 2 groups.

**Results**—All intervention patients took 1 drug for hypertension control and 93% of them took 3 such drugs, 15 control patients (15%) did not take any, and only 39% took 3 or more ( $P < .001$ ). Three-fourths (75%) of the intervention patients took the prescribed drugs regularly, whereas 66% of the control group ( $P = .034$ ) did so. Participation in the program was associated with lower annual out-of-pocket medical costs both overall and for outpatient services ( $P < .001$  for both).

**Conclusions**—Low-income rural residents in China receiving free drugs had enhanced medication adherence and reduced total medical costs. Providing hypertension drugs at no charge may be a promising strategy for preventing costly cardiovascular events associated with hypertension in China and other parts of the world with growing rates of cardiovascular disease.

Throughout the world, hypertension is the number one attributable risk factor for death, and its prevalence is increasing.<sup>1–4</sup> A report for 2001 estimated that worldwide, 14% of deaths and 6% of lost disability-adjusted-life-years were due to hypertension.<sup>5</sup> Although the

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developed countries account for the bulk of economic costs of hypertension, this disorder is responsible for a large and increasing economic and health burden in developing countries, and we can expect that an ever-increasing proportion of the costs is going to be borne by those countries.<sup>6,7</sup> For example, it has been predicted that the Asia Pacific region will bear about half of the world's cardiovascular burden, and high blood pressure is an important determinant of cardiovascular disease.<sup>8</sup> In China, the prevalence of hypertension has also been increasing over the past decade and in recent years reached as high as 39% among adults over age 35 years. Not surprisingly, the majority (62%) of strokes and about half (49%) of the cases of ischemic heart disease were attributable to hypertension.<sup>9,10</sup> Moreover, morbidity and mortality due to these 2 chronic conditions have been increasing rapidly in China in recent decades.<sup>11,12</sup> Given recent trends in cardiovascular disease in China, hypertension control has become a public health priority in that nation.

Fortunately, many effective pharmacologic treatments have become available for outpatient control of high blood pressure. Inpatient care for hypertension and its complications is expensive, but many hospitalizations may be avoided with the use of antihypertensive drugs.<sup>13</sup> The challenge is that patient adherence to antihypertensive medications remains poor in both developed and developing countries, and the lack of adherence to prescribed regimens constitutes a barrier to adequate blood pressure control and the prevention of cardiovascular events.<sup>14–18</sup> In addition, some researchers have demonstrated that poor adherence to antihypertensive medications is associated with a higher risk of vascular events and hospitalization, and greater healthcare costs.<sup>16–18</sup> An increased level of adherence to antihypertensive agents should result in a better health outcome for patients; therefore, providing a medication benefit may be a cost-effective policy option for improving population health.<sup>13,17,18</sup> Many researchers have investigated strategies to improve patients' adherence to medications in a cost-effective manner.<sup>19–23</sup>

Financial problems such as a lack of health insurance frequently affect patients' ability to control hypertension because the medications are unaffordable for low-income, rural residents in both developed and developing countries.<sup>13,19,23</sup> In 2 US studies, lower copayments for hypertension drugs were associated with improved adherence.<sup>20, 22</sup> However, there is limited evidence on the relationship between reducing the cost of hypertension medications and adherence to these medications, although studies have documented the growing problem of hypertension in rural China.<sup>24–26</sup> To fill in this gap, we evaluated the effectiveness of a medication subsidy program in rural communities in Shandong Province, China, by conducting and analyzing a face-to-face interview survey of hypertensive patients. The effectiveness was measured by patients' medication adherence status, economic burden of disease, and blood pressure levels.

## BACKGROUND OF THE MEDICATION SUBSIDY PROGRAM

In 2007, the health department of Shandong Province developed an initiative, Rural Health Care Workers Training and Non-communicable Disease Control Programs, which was supported by the government of Luxembourg through collaborations with the World Health Organization. The initiative focused primarily on (1) training rural healthcare workers in chronic disease control and prevention and (2) improving rural residents' awareness of

health risk factors and promoting a healthy lifestyle. Eight rural counties were selected to be the project counties. A baseline survey, which elicited information from families and also included a medical examination and laboratory testing, was conducted in the project counties from April 13 to May 1, 2007. This survey revealed that many patients with hypertension did not know the adverse health impacts of high blood pressure, and even if they had hypertension, they were not taking any antihypertensive drugs. These patients were more likely to have a low income and less likely to be able to afford antihypertensive drugs or obtain standard treatment. Overall, the rates of hypertension treatment and control were unacceptably low; thus, a program to subsidize the cost of medication was implemented in May 2008 in selected villages of all 8 counties.

## DETAILS OF THE PROGRAM

The subsidy program provided basic medicines at no charge for hypertensive patients in low-income families, as well as standard treatment and management as needed. The basic medication regimen, the NAH (nifedipine, atenolol, hydrochlorothiazide) program, was recommended by the China National Hypertension League. More generally, the program had 3 components: (1) At the initial clinic visit, the patient received a standard dose of medication according to blood pressure level, age, and sex (eg, nifedipine 2.5 mg 3 times daily, atenolol 6.25 mg once daily, or hydrochlorothiazide 6.25 mg once daily). The patient was asked to have a follow-up visit in 3 to 5 days. (2) At follow-up, the drug regimen was adjusted if needed according to blood pressure control status and drug complications. (3) If the 3 drugs could not bring the blood pressure under control, angiotensin-converting enzyme inhibitors, angiotensin II receptor antagonists, angiotensin II receptor blockers, and other drugs were added as appropriate. The patients received the hypertension drugs at no charge from the clinicians, and the clinicians were reimbursed 150 Chinese yuan per year for every patient served by the Rural Healthcare Workers Training and Non-communicable Disease Control Programs. (The 150 yuan was usually enough to cover the costs of hypertension drugs for each patient for a year in the rural communities.) The 3 main outcomes of interest were patient's medication adherence status, the economic burden of disease, and the blood pressure level. Medication adherence was determined by observing the patient's medication-taking behavior. The patient's economic burden of disease was total medical costs of chronic diseases associated with hypertension, including inpatient, outpatient, and medication costs.

## METHODOLOGY

In November 2009, about 18 months after the subsidy program began, a field survey in 2 townships in Cangshan County, 1 of the intervention counties, was conducted by trained researchers and graduate students from School of Public Health, Shandong University. In both townships, 2 villages were randomly selected as the project intervention sites. All hypertensive patients living in the villages were included. The survey involved holding face-to-face interviews with 110 hypertensive patients who received free hypertension drugs in the 4 villages (the intervention group) and 241 hypertensive patients of similar economic status who did not participate in the free medication program in 7 adjacent villages (the control group). A predesigned questionnaire covered major sociodemographic variables,

number of family members with high blood pressure, health complications, time since diagnosis, knowledge about hypertension, behaviors (following the doctor's advice and taking medication), and inpatient and outpatient medical expenses. The survey was designed to evaluate the effectiveness of a medication subsidy for low-income rural patients with noncommunicable diseases. The survey contained 15 forms that were developed and pilot-tested by a research team at Shandong University. We only analyzed the survey items related to hypertension (Appendix).

Blood pressure measurements were obtained from clinic technician records from 2009 (a year after the subsidy program began). Both systolic and diastolic blood pressures were measured twice in a 3- to 5-day interval. If either the systolic or diastolic measure differed by 6 or more mm Hg between the 2 measurements, a third measurement was taken. The average of the 2 or 3 measurements was recorded as the blood pressure level. Medical cost was collected from health insurance agencies and confirmed or supplemented by the face-to-face interview.

We used a 1:1 propensity-score matching technique to obtain patients for the intervention and control groups based on the information from our survey.<sup>27–30</sup> Because the intervention and control groups were not randomly selected, the distribution of characteristics among patients in the intervention group was quite different from that among patients in the control group, although we tried to select the patients with similar economic status in both groups (Table 1). It was possible that the distribution of their demographic characteristics (eg, age, sex, education) or of other factors could have biased our results when we compared the 2 groups. Thus, to minimize the potential bias in the analysis, we derived the matched samples using a logistic regression model based on patients' age, sex, education, marital status, economic status, health status, and insurance participation.<sup>27</sup> Then, using the matched sample populations, we compared medication-taking behavior, medical costs, and blood pressure control status. We used the  $\chi^2$  test for categorical variables and the Wilcoxon 2-sample test for continuous variables. All tests of statistical significance were 2-tailed, and because our study samples were small, we considered  $P < .05$  to indicate a significant difference. The SAS statistical package (Version 9.1, SAS, Cary, North Carolina) was used for all of the analyses.

## RESULTS

Before the propensity-score matching, 5 variables were found to differ significantly by group (Table 1): education, per capita income, health complications, time since patient was first diagnosed with hypertension, and knowledge of the relationship between hypertension and diet. These differences, if left uncorrected, would have biased the comparison analysis of medication-taking behaviors, medical costs, and blood pressure levels. After propensity-score matching, the 5 significant distribution differences in the population characteristics (Table 1) were greatly reduced, and only 1 of these characteristics, health complications ( $P < .05$ ), differed significantly between the intervention and control groups (Table 2). Thus, the 2 groups were now comparable and could be used for the comparison analysis.

Patients who received a medication subsidy were more likely to take some prescribed drugs for hypertension control than were unsubsidized patients ( $P < .001$ ; Table 3). In the intervention group, every patient took at least 1 prescribed drug for hypertension and 93.1% took 3 or more such drugs. In contrast, 14.7% of control group patients took no prescribed hypertension drugs at all and only 39.2% took 3 or more of these drugs.

In the intervention group, the percentage of patients who always took a prescribed hypertension drug and the percentage who took such drugs most of the time were higher than they were in the control group, but the difference in the overall pattern (taking medication regularly) was only significant at the  $P < .05$  level ( $P = .034$ ). For patients who did not regularly take a blood pressure medication, the main reason in both groups was “not feeling sick” followed by “forgetting.” The samples here were much smaller than for the other 2 items, and the overall difference between the intervention and control groups was not statistically significant ( $P = .782$ ).

Annual out-of-pocket medical costs (including inpatient, outpatient, and medications) were significantly lower for patients in the intervention group than for those in the control group (575 Chinese yuan vs 688 yuan;  $P < .001$ ) (Table 4). In addition, the median for total out-of-pocket costs was far lower for patients receiving the subsidy (120 yuan vs 228 yuan). The difference in out-of-pocket costs for outpatient visits, including medications, was significant (192 yuan vs 380 yuan;  $P < .001$ ). Finally, the out-of-pocket costs as a percentage of family income were much lower for patients receiving the subsidy (12.3% vs 27.7%;  $P < .001$ ).

Both systolic and diastolic blood pressures were not significantly lower for patients in the intervention group compared with the control group ( $P = .379$  and  $P = .544$ , respectively) (Table 5). Similarly, the proportion of patients with their hypertension under control was not significantly different between the intervention and control groups ( $P = .831$ ).

## DISCUSSION

By developing statistically similar samples for intervention and control groups using the propensity-score matching technique, we were able to estimate the effects of a drug subsidy program by comparing the outcomes of the 2 groups at a single time point. In that way, our study is different from other studies, which usually estimate a program's effect by comparing data from before and after the intervention.<sup>31,32</sup> Further, our use of the propensity-score matching method was only one of the analysis's strengths. For example, our study may be the first to investigate the effect on hypertension control in China of providing financial incentives directly to patients. Our results suggest that the subsidy increased medication adherence, which is consistent with evidence from abroad.<sup>13,20,22</sup> Moreover, although blood pressure measurements were not significantly lower for patients in the intervention group compared with patients in the control group, they were much lower than the blood pressure measurements before the intervention (in 2007). Thus, policy makers in China should consider subsidizing necessary drugs when they are developing hypertension control policies.

Another strength is that we collected information not only on medication-taking behavior, but also on relevant variables such as socioeconomic status, medical costs, and health status. Thus, the survey instrument we used might be useful for investigating the impacts of other health intervention programs such as initiatives to reduce sodium intake or to prevent stroke and diabetes, all of which are significant public health issues in today's China. "Not feeling sick" was the main reason for not regularly taking the medication in both the intervention and the control groups, which may suggest a need for further patient education. Finally, our results suggest that the medication subsidy reduced the total economic burden of chronic diseases for the patients, which is consistent with findings in developed countries.<sup>17,18,20,22,33,34</sup> This suggests a solid economic return from the intervention.

Its strengths notwithstanding, our study had several limitations that may limit its application to other settings. First, because the funding for our research was limited, we could interview only a small number of patients in the intervention and control villages for the evaluation. The relatively small sample might help to explain why some of our results were not statistically significant. Second, also because of our small sample, we conducted only univariate analyses; thus, we could not examine the effect of potential confounders on the program's impact. Correspondingly, we did not know how much of the difference in medication-taking behaviors and medical costs between the intervention and control groups was actually attributable to the subsidy program. More data and approaches using advanced econometric models would be required for such an evaluation. Finally, our evaluation period was too short to investigate the program's linkage to the incidence of health complications such as heart attack and stroke. We should also note that although patients' adherence to medication increased, their blood pressure levels did not decrease significantly. This might be in part because our sample was too small or because there was insufficient intensification of medications. Further investigation on the impact of a drug subsidy on blood pressure levels and associated complications such as heart attack and stroke should be carried out in the future.

## CONCLUSIONS

Our evaluation of a subsidy program focused on prescribed hypertension drugs indicates that it improved patients' adherence to taking such medication and reduced their financial burden in several different ways. Because poor adherence to medication regimens is common and the cost of medication is a major predictor of poor adherence,<sup>21,22,35–37</sup> subsidizing the costs of hypertension drugs may be a cost-effective policy option if it can reduce the complications of hypertension, prevent a large number of deaths, and contain the growing healthcare costs through a reduction in blood pressure. However, more economic research is needed to produce the evidence that such an intervention would be cost-effective in both developed and developing countries.

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## Appendix. Evaluation of the Policy Entitled Free Medicine for Low-income Patients With Non-communicable Disease

### Questionnaire for household survey

1. Name of the patient: \_\_\_\_\_ Patient code: \_\_\_\_\_



2. Address of the household: County Township Village: \_\_\_\_\_
3. Tel No. of the patient: \_\_\_\_\_
4. Name of the interviewer: \_\_\_\_\_ Interviewer code: \_\_\_\_\_
5. Date of survey: (year) (month) (day)

**Table 1**

Patient's General Information (If the patient is not available, other family member who knows him/her well should answer the survey)

1	Is the questionnaire answered by the patient? (1) Yes; (2) No, please specify the relationship between the patient and the interviewee	
2	Gender: (1) Male; (2) Female	
3	Age (years):	
4	Ethnicity: (1) Han; (2) Other, please specify	
5	Marital status: (1) Never married; (2) Married; (3) Divorced/Widowed	
6	Education: (1) < Elementary school; (2) < Middle school; (3) < High school, technical school, and technical secondary school; (4) < College; (5) College	
7	Main occupation: (1) Farmer; (2) Factory worker; (3) Village manager; (4) Technical personnel; (5) School teacher; (6) Village doctor; (7) Army staff; (8) Commercial business; (9) Immigration workers within the county; (10) Immigration workers outside the county; (11) Student; (12) Preschool child; (13) Other, please specify	
8	Which health plan do you have? (1) None; (2) New rural cooperative medical scheme; (3) Government employee plan; (4) Labor and semilabor plan; (5) Basic insurance plan for employees in urban areas; (5) Private insurance plan; (7) Other, please specify	

**Table 2**

Health Awareness and Knowledge About Hypertension and Diabetes

1	Do you think diet is associated with high blood pressure? (1) Yes; (2) No; (3) Unknown	
2	Do you think diet is associated with diabetes? (1) Yes; (2) No; (3) Unknown	
3	Do you think smoking is associated with high blood pressure? (1) Yes; (2) No; (3) Unknown	
4	Do you think smoking is associated with diabetes? (1) Yes; (2) No; (3) Unknown	
5	Is adiposity or overweight associated with high blood pressure? (1) Yes; (2) No; (3) Unknown	
6	Is adiposity or overweight associated with diabetes? (1) Yes; (2) No; (3) Unknown	

**Table 3**

Family Economic Status (should be answered by the member who knows the household most well)

1	How much were the household production costs (for farmers, this means the direct input into agriculture, ie, expenditure for seeds, fertilizer, pesticide, annual cost of farming machines, etc) in 2008?	
2	How much were the household living expenditures in 2008?	
2.1	Food expenditure:	
3	Expenditures for clothing and other daily life items:	
4	Expenditures for transportation and communication:	

5	Expenditure for housing, electricity, water, and fuel:	
6	Expenditures for culture, education, and entertainment:	
7	Expenditures for drugs, healthcare, and medical supplies:	
8	Expenditure for other household items:	
9	Does the household have any debt or loan? (1) Yes; (2) No; (3) No answer	
9.1	If yes, how much is it?	
9.2	If yes, what is the main reason that led the household into debt? (1) Lack of labor; (2) Natural disaster; (3) Disease or injury; (4) Education; (5) Marriage; (6) Other, please specify	
10	How do you consider the household's economic status in the village? (1) High income; (2) Above average; (3) Average; (4) Below average; (5) Poor	

\* The relationship of the respondent to the patient: (1) Self; (2) Spouse; (3) Parent; (4) Other, please specify

**Table 4**

Situations Related to Prescribed Medications for Patients With Hypertension (people with high blood pressure, please continue to Tables 4–8)

1	Your date of diagnosis of high blood pressure (year/month)	
1.1	Where was the diagnosis performed? (1) Village health clinic; (2) Private clinic; (3) Township health center; (4) County-level hospitals; (5) Hospitals above county level; (6) No diagnosis; (7) Other, please specify	
2	The severity of your high blood pressure symptoms: (1) No symptoms; (2) Mild discomfort, symptoms do not affect the normal working life; (3) Moderate discomfort, not able to do some work, but symptoms do not affect the daily living; (4) Unable to work; (5) Severe discomfort, stay in bed	
2.1	Do you have other complications of high blood pressure (eg, coronary heart disease, stroke, hypertensive heart disease, nephropathy)? (1) No; (2) Yes	
2.2.1	What is the classification of your high blood pressure? (1) I; (2) II; (3) III; (4) Unknown	
2.2.2	How much can you control your blood pressure to now? (1) Control to mm Hg/mm Hg; (2) Unknown	
2.2.3	How much was your blood pressure when it was tested lately?	
2.2.4	Do you know the range of normal blood pressure? (1) Yes, is mm Hg/mm Hg; (2) No	
2.2.5	Judged by the investigator, whether the patients' answer to normal blood pressure range is right? (1) Yes; (2) No	
3.1.1	After being diagnosed with high blood pressure, how often should you measure your blood pressure according to the doctor's advice? (1) Once a day; (2) At least once a week; (3) At least once a month; (4) At least once a season; (5) No need to measure; (6) Not told by doctor; (7) Other, please specify	
3.1.2	After being diagnosed with high blood pressure, how often do you measure your blood pressure? (1) Once a day; (2) At least once a week; (3) At least once a month; (4) At least once a season; (5) No need to measure; (6) Not told by doctor; (7) Other, please specify	
3.1.3	What is the main reason why you do not regularly monitor the blood pressure and have periodic reexamination? (1) Disease is not serious, no need to; (2) Family financial difficulties; (3) Too much trouble, do not have the time; (4) Do not know how to monitor blood pressure and periodic reexamination; (5) Already have the disease, no matter what; (6) Other, please specify	
3.2.1	After you were diagnosed with high blood pressure, did the doctor tell you that you should not smoke? (1) Nonsmoker; (2) Yes; (3) No; (4) Unclear; (5) Other, please specify	
3.2.2	After you were diagnosed with high blood pressure, did the doctor tell you that you should limit drinking alcohol? (1) Nondrinker; (2) Yes; (3) No; (4) Unclear; (5) Other, please specify	
3.2.3	After you were diagnosed with high blood pressure, did the doctor tell you that you should adjust or control diet? (1) Yes; (2) No; (3) Unclear; (4) Other, please specify	
3.2.4	After you were diagnosed with high blood pressure, did the doctor recommend that you get appropriate physical activity? (1) Yes; (2) No; (3) Unclear; (4) Other, please specify	
3.3	Has the doctor asked you to take medicine therapy? (1) Yes; (2) No	

3.3.1	Did the doctor tell you that you should take medication consistently to control your blood pressure? (1) Yes; (2) No; (3) Don't remember	
3.4	Does anyone in your family (parents and siblings) have hypertension? (1) Yes; (2) No; (3) Not clear	

**Table 5****Medication Utilization for Patients with Hypertension**

1.1	How many kinds of medications are you taking?	
1.2	The medications you are taking are: The first: ____ The second: ____ The third: ____	
2	Do all the medications you are taking now belong to the prescribed list (meaning that you can apply for reimbursement from the new Rural Cooperative Medical Scheme [RCMC])? (1) Yes; (2) No; (3) Don't know If you choose (2), please answer questions 2.1 and 2.2, otherwise skip to question 3 immediately	
2.1	Why did you choose the medication that is not on the prescribed list? (1) Better effect; (2) Doctor's suggestion; (3) Other, please specify	
2.2	Given that medications not on the prescribed list cannot be reimbursed by RCMC or by the project (Free Medicine for Low-income Patients With Non-communicable Disease), do you think that the cost will influence your treatment decisions? (1) Yes; (2) No; (3) Have no idea	
3	Are you taking your hypertension medication regularly? (1) Always; (2) Most times; (3) Sometimes; (4) Only take medication when it comes to mind; (5) Only take medication when feeling uncomfortable	
3.1	Do you know that taking medications regularly is beneficial to control your disease? (1) Yes; (2) No	
3.2	What is the biggest obstacle that prevents you from taking medication regularly? (1) Not applicable; (2) No uncomfortable feeling; (3) Too busy or forget; (4) Other, please specify	
4	Do you take medications according to doctor's orders? (1) Take medications according to the quantities suggested; (2) Take more medications than the quantities suggested; (3) Take fewer medications than the quantities suggested; (4) Based on health status, take more or fewer medications; (5) Other, please specify	

**Table 6****Implementation of the Free Medicine for Low-income Patients With Non-communicable Disease Policy and Patient Attitudes (if you were covered by the free medicine policy, then please fill in this form)**

1.1	Are you satisfied with the free medicine policy for poor patients with non-communicable disease (including the implementation plan and the amount of the compensation)? (1) 100% satisfaction; (2) 80% satisfaction; (3) 50% satisfaction; (4) 20% satisfaction; (5) Not satisfied	
1.2	Can you give any comments about the policy?	
1.3	Do you know that how much money you can get from the project (patients in counties other than Cangshan country)? (1) Understand totally, and say the specific number; (2) Know a little information; (3) Unknown	
1.4	What kind of medicines can you get for free from the project? (patients in Cangshan county)	

**Table 7****Cost of Outpatient Care for Patients With Hypertension**

1	How much do you currently spend for medications to control blood pressure every month?	
2	How much did you spend in 2008 to treat your hypertension and its complications?	
2.1	How much was covered by the New Rural Cooperative Medical Scheme?	

2.2	How much was covered by other health plans?	
2.3	How much was covered by the project?	
3	At which facility did you primarily purchase medications? (1) Drugstore; (2) Village clinic; (3) Township health center; (4) County hospital; (5) Other, please specify	
3.1	Why did you choose this facility? (1) Close to my house; (2) Low price; (3) Covered by health plans; (4) Other, please specify	
4	When was the last time you saw a doctor for hypertension? (1) < 1 month; (2) 1–2 months; (3) 2–3 months; (4) 3–6 months; (5) 6–12 months; (6) >12 months	
4.1	Where did you see a doctor for hypertension the last time? (1) Village clinic; (2) Private clinic; (3) Township health center; (4) County hospital; (5) Other, please specify	
4.1.1	Why did you select that institution? (1) Close to my home; (2) Low price; (3) Good quality; (4) It is assigned; (5) Friends work there; (6) Have reliable doctors; (7) Staff are kind; (8) Recommended by someone; (9) Other, please specify	
4.2	What were the total medical charges from this institution?	
4.2.1	How much was covered by public health plans?	
4.2.2	How much was covered by private health plans?	
4.2.3	How much was covered by this project?	
5	Have you been hospitalized because of hypertension or a related complication the last year? (1) Yes; (2) No	
6	Last year, did a doctor recommend that you be hospitalized because of hypertension or a related complication, but you rejected hospitalization? (1) Yes; (2) Was hospitalized according the doctor's order	
6.1	If you refused the inpatient service, why did you refuse (single choice)? (1) Did not perceive illness severe enough; (2) No time; (3) Financial difficulty; (4) Poor service quality of the hospital; (5) No bed available; (6) Too far, lack of transportation; (7) Other, please specify	

**Table 8**

Hospitalization of Patients With Hypertension Last Year (if the patient was not hospitalized, please do not fill this form)

1	The primary reason you were in the hospital: (1) Hypertension; (2) Coronary heart disease; (3) Myocardial infarction; (4) Cerebral infarction; (5) Cerebral hemorrhage; (6) Hypertensive renal disease; (7) Hypertensive heart disease; (8) Other, please specify	
2	How many times have you been in the hospital for this disease last year?	
3	Where were you hospitalized? (1) Township health center; (2) County hospital; (3) Prefecture hospital; (4) Other, please specify	
4	Why did you select that institution? (1) Close to my home; (2) Low price; (3) Good quality; (4) It is assigned; (5) Friends work there; (6) Have reliable doctors; (7) Staff are kind; (8) Recommended by someone; (9) Other, please specify	
5	What was the length of your stay in the hospital (days)?	
6	What were the total medical charges (hospitalization, drugs, supplies, etc) for these hospitalizations?	
6.1	How much of the charges were covered by public health plan?	
6.2	How much of the charges were covered by other health plans?	
6.3	How much was spent on transportation and food related to these hospitalizations?	

**Table 9**

## Field Measurement of Blood Pressure

Did you take any medicine like hypotensor, vasodilator drug, diuretic, or sedative drugs today <input type="checkbox"/> Yes <input type="checkbox"/> No	
SBP1/DBP1: the first measurement	SBP1: <input type="text"/> mm Hg, DBP1: <input type="text"/> mm Hg
SBP2/DBP2: the second measurement	SBP2: <input type="text"/> mm Hg, DBP2: <input type="text"/> mm Hg
If the difference between SBP1 and SBP2 or DBP1 and DBP2 is equal to or more than 6 mm Hg, please measure the third time: SBP3/DBP3	SBP3: <input type="text"/> mm Hg, DBP3: <input type="text"/> mm Hg
Signature of the surveyor	

### Take-Away Points

In both developed and developing countries, the control rate for hypertension is unacceptably low, and poor adherence to medication is a primary reason.

- A free medication program is effective in improving adherence and reducing total medical costs in rural communities in China.
- The impact of the program on blood pressure levels and disease outcomes requires further investigation.



**Table 1**

Characteristics of the Intervention (n = 110) and Control (n = 241) Groups Before Matching of the Samples

Characteristic	No. (%)		$\chi^2$ or <i>t</i> Test ( <i>P</i> )
	Intervention Group	Control Group	
<b>Male</b>	50 (45.5)	129 (53.5)	1.97 (.161)
<b>Age, y</b>			
<55	24 (21.8)	37 (15.4)	3.50 (.321)
55–64	31 (28.2)	69 (28.6)	
65–74	32 (29.1)	90 (37.3)	
75	23 (20.9)	45 (18.7)	
<b>Education</b>			
<Elementary	80 (72.7)	123 (51.0)	14.65 (.001)
Elementary to middle school	15 (13.6)	63 (26.1)	
>Middle school	15 (13.6)	55 (22.8)	
<b>Marital status</b>			
Never married	1 (0.9)	6 (2.5)	0.99 (.611)
Married	87 (79.1)	186 (77.2)	
Widowed	22 (20.0)	49 (20.3)	
<b>Farmers</b>	102 (92.7)	209 (86.7)	2.70 (.101)
<b>New cooperative medical coverage</b>	103 (93.6)	226 (93.8)	0.003 (.960)
<b>Annual per capita income, yuan</b>			
<2300	52 (49.1)	56 (23.9)	21.27 (<.001)
2300–4199	25 (23.6)	80 (34.2)	
4200	29 (27.4)	98 (41.9)	
<b>Number of family members having hypertension</b>			
At least 1	43 (39.1)	98 (40.7)	1.63 (.442)
None	52 (47.3)	121 (50.2)	
Unknown	15 (13.6)	22 (9.1)	
<b>Health complications</b>			
Yes	87 (79.1)	155 (64.3)	8.99 (.011)
No	18 (16.4)	76 (31.5)	
Unknown	5 (5.4)	9 (3.7)	
<b>Time since first diagnosed with hypertension, y</b>			
<4	47 (43.5)	75 (31.9)	11.31 (.004)
4–10	43 (39.8)	80 (34.0)	
11	18 (16.7)	0 (34.0)	
<b>Health awareness</b>			
Hypertension and diet	87 (77.8)	142 (62.8)	7.46 (.006)
Hypertension and smoking	76 (70.4)	137 (60.6)	3.01 (.083)
Hypertension and body weight	64 (59.3)	122 (54.0)	0.83 (.364)

Characteristic	No. (%)		$\chi^2$ or <i>t</i> Test ( <i>P</i> )
	Intervention Group	Control Group	
Hypertension and regular medication	101 (91.8)	205 (95.8)	2.19 (.139)
<b>Systolic blood pressure in 2007 (mm Hg, mean <math>\pm</math> SE)</b>	161.8 $\pm$ 18.9	160.2 $\pm$ 23.6	0.61 (.540)
<b>Diastolic blood pressure in 2007 (mm Hg, mean <math>\pm</math> SE)</b>	91.8 $\pm$ 12.1	92.1 $\pm$ 11.8	0.19 (.849)

SE indicates standard error.

**Table 2**

Characteristics of the Intervention (n = 102) and Control (n = 102) Groups After Matching of the Samples

Characteristic	No. (%)		$\chi^2$ or <i>t</i> Test ( <i>P</i> )
	Intervention Group	Control Group	
<b>Male</b>	46 (45.1)	49 (48.0)	0.177 (.674)
<b>Age, y</b>			
<55	24 (23.5)	15 (14.7)	3.45 (.327)
55–64	29 (28.4)	27 (26.5)	
65–74	29 (28.4)	38 (37.3)	
75	20 (19.6)	22 (21.6)	
<b>Education</b>			
<Elementary	74 (72.5)	66 (64.7)	1.89 (.388)
Elementary to middle school	14 (13.7)	21 (20.6)	
>Middle school	15 (13.7)	15 (14.7)	
<b>Marital status</b>			
Never married	1 (1.0)	0 (0)	3.78 (.151)
Married	84 (82.4)	75 (73.5)	
Widowed	17 (16.7)	27 (26.5)	
<b>Farmers</b>	94 (92.2)	93 (91.2)	0.06 (.800)
<b>New cooperative medical coverage</b>	95 (93.1)	98 (96.1)	0.87 (.352)
<b>Annual per capita income, yuan</b>			
<2300	51 (50.0)	41 (40.2)	2.34 (.310)
2300–4199	23 (22.5)	31 (30.4)	
4200	28 (27.5)	30 (29.4)	
<b>Number of family members having hypertension</b>			
At least 1	41 (40.2)	33 (32.4)	1.48 (.477)
None	48 (47.1)	56 (54.9)	
Unknown	13 (12.7)	13 (12.7)	
<b>Health complications</b>			
Yes	81 (79.4)	66 (64.7)	9.30 (.010)
No	16 (15.7)	34 (33.3)	
Unknown	5 (4.9)	2 (2.0)	
<b>Time since first diagnosed with hypertension, y</b>			
<4	44 (43.1)	43 (42.2)	1.73 (.421)
4–10	42 (41.2)	36 (35.3)	
11	16 (15.7)	23 (22.5)	
<b>Health awareness</b>			
Hypertension and diet	79 (77.5)	75 (73.5)	0.42 (.515)
Hypertension and smoking	73 (71.6)	64 (62.7)	1.80 (.180)
Hypertension and body weight	61 (59.8)	53 (52.0)	1.27 (.259)

Characteristic	No. (%)		$\chi^2$ or <i>t</i> Test ( <i>P</i> )
	Intervention Group	Control Group	
Hypertension and regular medication	94 (92.2)	96 (94.1)	0.31 (.580)
Systolic blood pressure in 2007 (mm Hg, mean $\pm$ SE)	161.5 $\pm$ 19.3	160.3 $\pm$ 23.4	0.42 (.679)
Diastolic blood pressure in 2007 (mm Hg, mean $\pm$ SE)	92.1 $\pm$ 12.4	90.2 $\pm$ 11.6	1.09 (.28)

SE indicates standard error.

**Table 3**

Comparison of Hypertension Medication Status Between Intervention (N = 102) and Control (N = 102) Groups

Medication Status	No. (%)		P
	Intervention Group	Control Group	
Taking prescribed medication			
No	0 (0)	15 (14.7)	<.001
1 or 2 types of drugs	7 (6.9)	47 (46.1)	
3 types of drugs	95 (93.1)	40 (39.2)	
Taking prescribed medication regularly			
Always	76 (74.5)	67 (65.7)	.034
Most of the time	9 (8.8)	5 (4.9)	
Some of the time	10 (9.8)	5 (4.9)	
When feeling sick	7 (6.9)	10 (9.8)	
Never	0 (0)	15 (14.7)	
Reasons for not regularly taking medication			
	n = 26	n = 35	
Cannot afford	1 (3.8)	2 (5.7)	.782
Not feeling sick	16 (61.5)	25 (71.4)	
Forgetting	7 (26.9)	6 (17.1)	
Other	2 (7.7)	2 (5.7)	

**Table 4**

Comparison of Annual Medical Costs (Chinese Yuan) for Patients With Hypertension

Annual Medical Costs	Mean $\pm$ SE (Median), Yuan		<i>P</i>
	Intervention Group (n = 98)	Control Group (n = 94)	
Out-of-pocket costs, including inpatient, outpatient, and medications	574.5 $\pm$ 1933.8 (162.0)	687.8 $\pm$ 1303.7 (228.0)	<.001
Out-of-pocket costs for outpatient visits, including medications	191.9 $\pm$ 443.4 (157.0)	380.0 $\pm$ 552.8 (200.0)	<.001
Total out-of-pocket costs as a percentage of family income	12.3 $\pm$ 32.6 (5.0)	27.7 $\pm$ 58.2 (8.6)	<.001



**Table 5**

Blood Pressure Control Status of Intervention (n = 102) and Control (n = 102) Groups

Control Status	Intervention Group	Control Group	<i>P</i>
<b>Blood pressure, mm Hg, mean ± SE</b>			
Systolic	151.2 ± 16.5	153.4 ± 18.4	.379
Diastolic	87.1 ± 12.2	88.1 ± 9.9	.544
<b>Under control, n (%)</b>	13 (12.7)	12 (11.8)	.831
<b>Uncontrolled, n (%)</b>	89 (87.3)	90 (88.2)	

SE indicates standard error.